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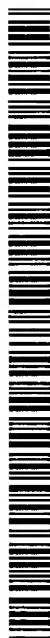
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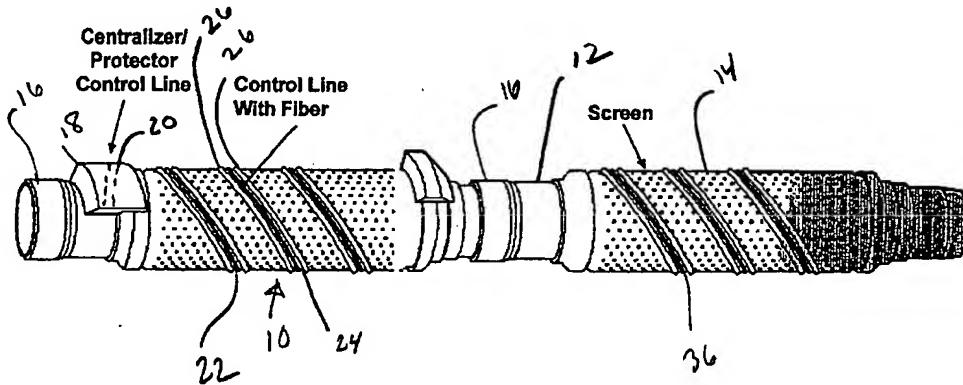
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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: EXPANDABLE SCREEN WITH AUXILIARY CONDUIT



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(57) Abstract: An expanding screen (10) with an associated spirally wrapped exterior control line (22) is disclosed. The control line rests in a spiral trough (24) made up in an exterior perforated jacket. The trough can be made by a pair of ridges (26) disposed substantially parallel to each other or by an ordered spacing of raised dimples in the outer perforated jacket to create spiral troughs. At the screen connections centralizers (18) having a spiral path or paths within can serve a dual function of locating the screen prior to a expansion and protecting the control line in the joint area. A fiber optic cable can be placed in the control line.

APPLICATION FOR PATENT

Title: EXPANDABLE SCREEN WITH EXTERNAL CONDUIT
Inventor: Bennett M. Richard

FIELD OF THE INVENTION

[0001] The field of this invention is downhole screens that can be expanded in place and, more particularly screens that include a communication conduit to permit monitoring of downhole conditions.

BACKGROUND OF THE INVENTION

[0002] Screens have long been used in combination with sand or other proppants to hold open perforations in a formation and to prevent production of particulates from the formation from clogging up the production screens. The common procedure for doing this is known as gravel packing. Eventually, the concept of screen expansion took hold as a possible alternative to gravel packing. In this more recent development, the annular space around the screen was eliminated due to its expansion. The borehole wall would then be in contact with the outermost layer of the screen and the need to deposit sand or other proppants was eliminated in certain applications. Expanding screens are illustrated in U.S. Patent 6,263,972.

[0003] Previously, when gravel packing screens, it was known to provide a control line or conduits for a variety of reasons. Conduits running along a screen could be used to move gravel around a sand bridge during deposition of gravel. Such conduits could also carry fiber optics for the purpose of communicating downhole conditions to the surface. This concept is illustrated in U.S. Patent 6,409,219. Methods for fabricating screens have also been developed. For example, U.S. Patent 6,305,468 illustrates joining layers of a non-expanding screen by putting the layers through a die after rolling them together. This technique allowed welds to be eliminated to improve the reliability of the finished product.

[0004] The prior designs did not address the issue of how to provide surface communication of downhole conditions when using an expanding screen. There are special conditions to consider when providing a communication conduit in conjunction with an expanding screen. The screen tends to shorten in length as it is expanded. The screen is expanded into a borehole wall. The communication

conduit is exposed outside the screen during run in and could get damaged. These issues are all addressed by the present invention. The nature of the solutions will be more apparent to those skilled in the art from a review of the description of the preferred embodiment and the claims, which appear below.

SUMMARY OF THE INVENTION

[0005] An expanding screen with an associated spirally wrapped exterior control line is disclosed. The control line rests in a spiral trough made up in an exterior perforated jacket. The trough can be made by a pair of ridges disposed substantially parallel to each other or by an ordered spacing of raised dimples in the outer perforated jacket to create spiral troughs. At the screen connections centralizers having a spiral path or paths within can serve a dual function of locating the screen prior to expansion and protecting the control line in the joint area. A fiber optic cable can be placed in the control line.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Figure 1 is an outer view of the screen showing the control line in a spiral trough on the outer jacket;

[0007] Figure 2 is an unrolled view of the outer jacket shown in Figure 1 showing the parallel protrusions that make up the spiral path when the sheet is rolled on an angle and the seams are joined;

[0008] Figure 3 is an alternate embodiment to Figure 2 showing an array of dimples that produce a trough when the sheet is rolled at an angle and the seams are joined.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0009] Referring to Figure 1, a screen 10 comprises a perforated base pipe 12 with an overlay of a filter media (not shown). Covering the filter media is an outer shroud 14. Screen 10 is made up in joints 16 for ultimate connection to a packer (not shown) in a manner known in the art. At or near the connections 16, there are disposed one or more centralizers 18. Centralizers 18 have one or more generally spirally oriented paths 20 to accept one or more control lines 22. As shown in Figure 1, the control line 22 is disposed in a spiral trough 24. Preferably, the depth of the trough is as deep or deeper than the diameter of the line 22. A pair of generally parallel ridges 26 whose pitch can be varied to get the desired number of revolutions of the line 22 in any given section of screen 10 between the joints 16 makes the trough. The ridges 26 can be seen in Figure 2.

[0010] In this view, the outer shroud 14 is laid out as a flat sheet. It receives perforations 28 which can be stamped in the sheet as well as the troughs 26. It will be appreciated that edges 30 and 32 are ultimately joined to form a spiral seam as opposed to a seam in line with the longitudinal axis of the cylindrical shape formed. The angle on which sheet 34 is rolled will determine the pitch of the trough 24. The seam between edges 30 and 32 can be welded or sealed in another manner. A fiber optic cable or cables 36 can be run within line 22. It can be routed in mechanically during assembly or pumped in after the sections of screen 10 and associated lines 22 are assembled and run into position in the wellbore.

[0011] Figure 3 is an alternate embodiment to Figure 2. In Figure 3 a sheet 36 is perforated with small openings 38. Interspersed among the openings 38 are protrusions 40 with preferably each having an opening 42, although they may be closed as well. Protrusions 40 are in preferably parallel rows such as 44, 46, and 48. There are some protrusions between the rows such as 50 and 52. These help to guide the line or lines 22 in the spiral path created when sheet 36 is rolled into a cylindrical shape making a spiral seam of edges 54 and 56, which can be joined by welding or other ways that are equivalent. The height 58 of the protrusions 40 can be varied or uniform. Preferably the height 58 approximates the diameter of the line or lines 22. The pitch of the spiral trough 24 that can also be created with protrusions 40 can be varied depending on the angle that sheet 36 is rolled, akin to the technique for rolling sheet 34.

[0012] Those skilled in the art will appreciate that using the troughs 24 will protect the line or lines 22 during run in. During expansion, the spiral winding readily accommodated the longitudinal shrinkage in the overall screen length that occurs. The centralizers 18 allow the spiral path to continue from one filter section to the next. The placement of the line or lines 22 is facilitated by the ready access to the trough 24. After expansion, the jacket openings 38 are not pressed into the borehole wall filter cake because the protrusions 40 act as a standoff. Accordingly, the flow to the filter media below the outer shroud 14 is enhanced after expansion of the screen into the borehole wall.

[0013] While the preferred embodiment has been described above, those skilled in the art will appreciate that other mechanisms are contemplated to accomplish the task of this invention, whose scope is delimited by the claims appended below, properly interpreted for their literal and equivalent scope.

I claim:

1. An expanding screen assembly for downhole use, comprising:
a screen comprising a circumscribing exterior pathway.
2. The assembly of claim 1, further comprising:
at least one conduit in said pathway.
3. The assembly of claim 2, wherein:
said pathway is at least as deep as the height of said conduit.
4. The assembly of claim 1, wherein:
said pathway comprises a spiral.
5. The assembly of claim 1, wherein:
said screen comprises an outer jacket with a plurality of openings and said pathway is on said jacket.
6. The assembly of claim 5, wherein:
said pathway on said jacket comprises a plurality of elongated projections.
7. The assembly of claim 6, wherein:
said projections are substantially parallel on said jacket when said jacket is in the form of a flat sheet before it is rolled into a cylindrical shape.
8. The assembly of claim 7, wherein:
the pitch of a spiral path defined by said substantially parallel projections is determined by the angle that said flat sheet is rolled into a cylindrical shape.

9. The assembly of claim 5, further comprising:
at least one centralizer comprising a path through it that acts as a continuation of said pathway.
10. The assembly of claim 9, wherein:
said screen comprises an assembly of screen sections each having ends with a connection and
said at least one centralizer comprises at plurality of centralizers mounted adjacent said ends.
11. The assembly of claim 5, wherein:
said pathway on said jacket comprises a plurality of projections.
12. The assembly of claim 11, wherein:
said projections are symmetrical.
13. The assembly of claim 12, wherein:
said projections are round.
14. The assembly of claim 11, wherein:
said projections are arranged in rows on said jacket when said jacket is in the form of a flat sheet before it is rolled into a cylindrical shape.
15. The assembly of claim 14, wherein:
said rows are substantially parallel.
16. The assembly of claim 15, wherein:
additional projections are disposed between rows.

17. The assembly of claim 15, wherein:
the pitch of a spiral path defined by said substantially parallel projections is determined by
the angle that said flat sheet is rolled into a cylindrical shape.
18. The assembly of claim 13, wherein:
said projections further comprise openings thereon.
19. The assembly of claim 5, further comprising:
at least one conduit in said pathway; and
said pathway is at least as deep as the height of said conduit.
20. The assembly of claim 11, further comprising:
at least one conduit in said pathway; and
said pathway is at least as deep as the height of said conduit.
21. The assembly of claim 19, further comprising:
at least one fiber optic cable in said conduit.
22. The assembly of claim 20, further comprising:
at least one fiber optic cable in said conduit.

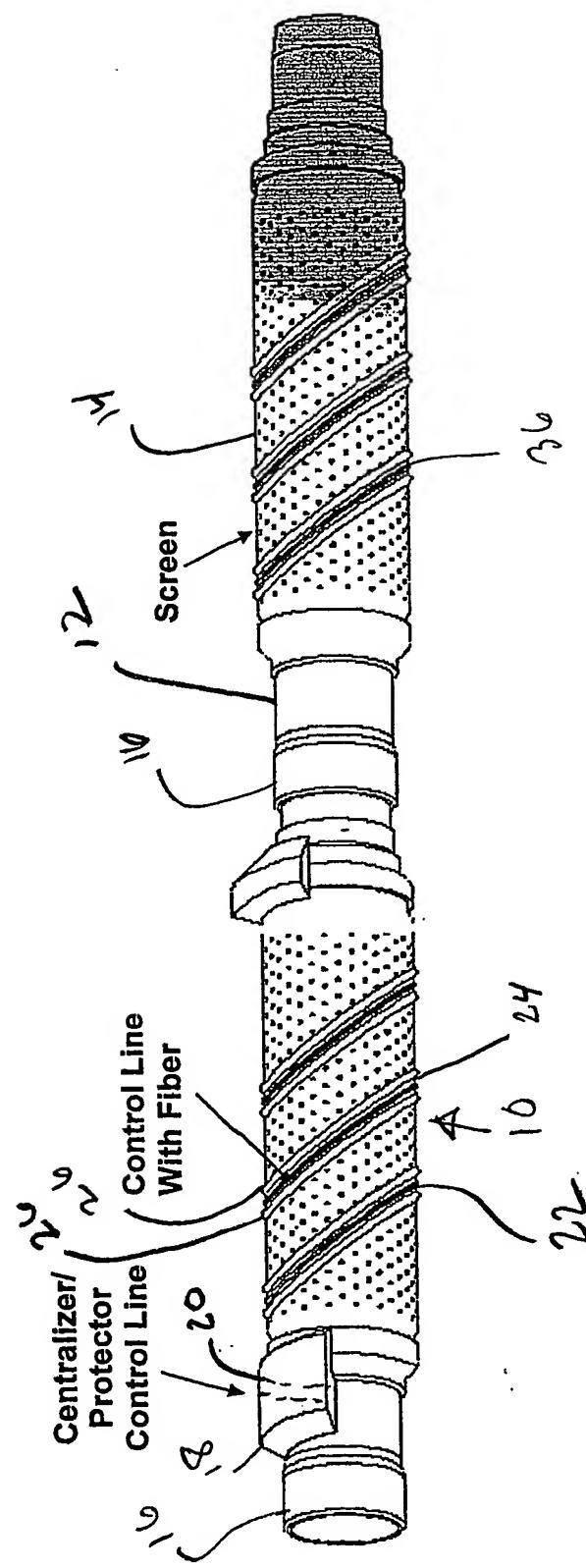


Figure 1

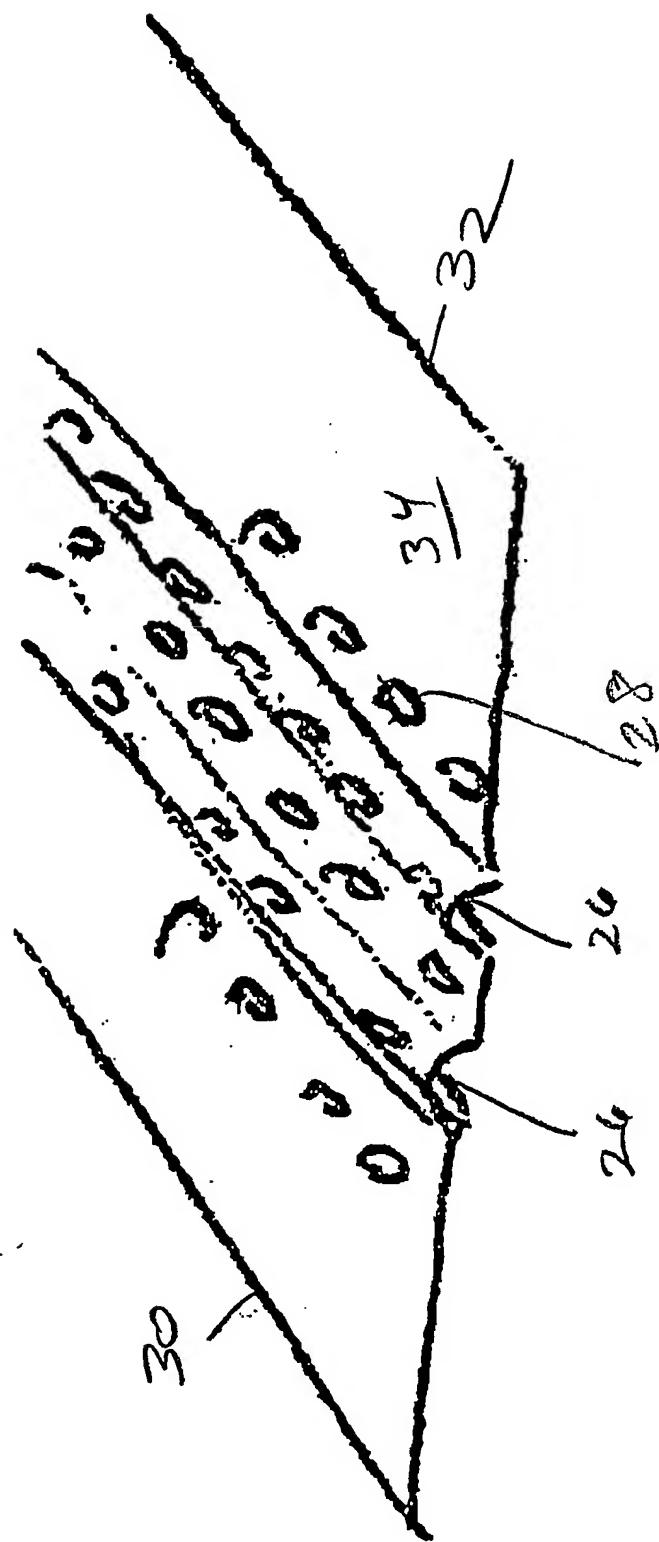


Figure 2

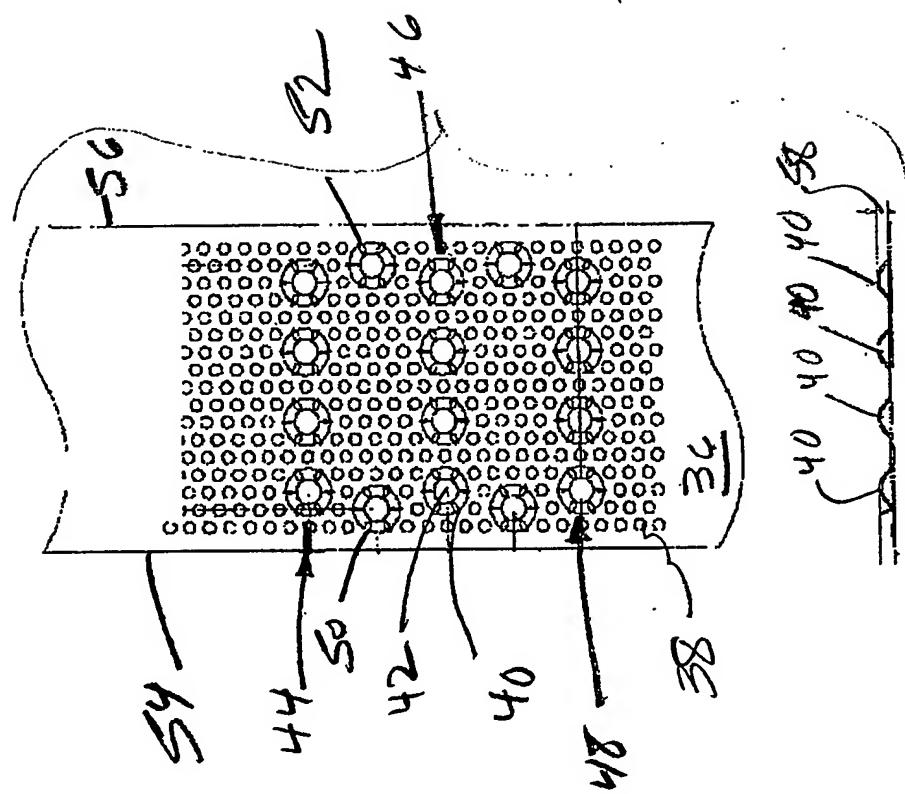


Figure 3

INTERNATIONAL SEARCH REPORT

International Application No

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A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 E21B43/10 E21B43/08 E21B17/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHEDMinimum documentation searched (classification system followed by classification symbols)
 IPC 7 E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2002/092649 A1 (HACKWORTH MATTHEW R ET AL) 18 July 2002 (2002-07-18) page 2, paragraph 23; figures 4,18-20 page 3, paragraph 37 -page 4, paragraph 41	1-6, 11-13, 19-22
Y	---	7-10,14, 15,17
Y	EP 1 152 120 A (HALLIBURTON ENERGY SERV INC) 7 November 2001 (2001-11-07) column 11, line 20 - line 43; figure 7 ---	7,8,14, 15,17
Y	US 3 933 203 A (EVANS ORDE R) 20 January 1976 (1976-01-20) See abstract figure 1 ---	9,10 -/-

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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Date of the actual completion of the International search

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INTERNATIONAL SEARCH REPORT

International Application No

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 369 382 A (SCHLUMBERGER HOLDINGS) 29 May 2002 (2002-05-29) claim 1; figure 2 -----	1
A	US 2002/007948 A1 (FALCONER GRAEME H ET AL) 24 January 2002 (2002-01-24) figures 6,9,10,16 -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 03/20545

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 2002092649	A1	18-07-2002	US 2002104655 A1 US 2002092648 A1 US 2002125008 A1 US 2002125009 A1 CN 1369615 A GB 2371063 A ,B NO 20020223 A BR 0200866 A CA 2367859 A1		08-08-2002 18-07-2002 12-09-2002 12-09-2002 18-09-2002 17-07-2002 17-07-2002 24-09-2002 16-07-2002
EP 1152120	A	07-11-2001	US 6457518 B1 AU 3878601 A BR 0101997 A CA 2346441 A1 EP 1152120 A2 SG 91921 A1 US 2002129935 A1		01-10-2002 08-11-2001 26-12-2001 05-11-2001 07-11-2001 15-10-2002 19-09-2002
US 3933203	A	20-01-1976	NONE		
GB 2369382	A	29-05-2002	US 2002053439 A1 CA 2360472 A1 GB 2382831 A ,B US 2002125008 A1 US 2002125009 A1		09-05-2002 03-05-2002 11-06-2003 12-09-2002 12-09-2002
US 2002007948	A1	24-01-2002	AU 1001901 A CA 2330402 A1 GB 2359834 A NO 20010068 A		12-07-2001 06-07-2001 05-09-2001 06-07-2001